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things'' or by logic or by the muses upon the creative activity of the human spirit.

Consider next, the critic might say, our human craving for a living sense of rapport and comradeship with a divine Being infinite and eternal. Except through the modern mathematical doctrine of infinity, there is, he would have to say, no rational way by which we may even approximate an understanding of the supernal attributes with which our faculty of idealization has clothed Deity—no way, except this, by which our human reason may gaze understandingly upon the downward-looking aspects of the overworld. But this is not all. I need not, he would say, remind you of the reverent saying attributed to Plato that "God is a geometrician." Who is so unfortunate as not to know something of the religious awe, the solace and the peace that come from cloistral contemplation of the purity and everlastingness of mathematical truth?

Mighty is the charm of those abstractions to a mind beset with images and haunted by himself.

"More frequently," says Wordsworth, speaking of geometry,

More frequently from the same source I drew
A pleasure quiet and profound, a sense
Of permanent and universal sway,
And paramount belief; there, recognized
A type, for finite natures, of the one
Supreme Existence, the surpassing life
Which to the boundaries of space and time,
Of melancholy space and doleful time,
Superior and incapable of change,
Not touched by welterings of passion—is,
And hath the name of God. Transcendent peace
And silence did wait upon those thoughts
That were a frequent comfort to my youth.

And so our spokesman, did time allow, might continue, inviting his auditors to consider the relations of mathematics to yet other great ideals of humanity—our human craving for rectitude of thought, for ideal justice, for dominion over the

energies and ways of the material universe, for imperishable beauty, for the dignity and peace of intellectual harmony. We know that in all such cases the issue of the great critique would be the same, and it is needless to pursue the matter further. The light is clear enough. Mathematics is, in many ways, the most precious response that the human spirit has made to the call of the infinite and eternal. It is man's best revelation of the "Deep Base of the World."

CASSIUS J. KEYSER

COLUMBIA UNIVERSITY

THE NATIONAL ACADEMY OF SCIENCES
PRELIMINARY PROGRAM OF SCIENTIFIC PAPERS FOR
THE AUTUMN MEETING, NOVEMBER 15-17

THE National Academy of Sciences will hold its stated autumn meeting at the American Museum of Natural History, New York City, on November 15, 16 and 17. The council will meet at 4 P.M. on Monday, November 15. There will be a lecture on "The Problem of Aerial Transmission" by Professor M. I. Pupin, of Columbia University, at 8 P.M., followed by a reception in the museum. On Tuesday and Wednesday morning at 9:30 A.M. there will be business sessions of the academy, followed at 10:30 by public scientific sessions. On the afternoon of November 16, there will be four papers of general interest. On the afternoon of November 17, luncheon will be served at the New York Zoological Park, followed by a visit to the New York Botanical Garden and afternoon tea. There will be a dinner on the evening of November 16 at the Chemists' Club.

The preliminary program of scientific papers is as follows:

The Nature of Cell Polarity: EDWIN G. CONKLIN.

Heredity of Stature: CHAS. B. DAVENPORT.

Parental Alcoholism and Mental Ability, a Comparative Study of Habit Formation in the White Rat: E. C. MACDOWELL. (Introduced by CHARLES B. DAVENPORT.)

The purpose of this investigation is to compare the mental capabilities of rats whose parents were

alcoholic with those of rats of normal parentage. It is commonly claimed that in man, the children of alcoholics are less teachable than children of normals. However, the exceeding difficulty of obtaining genetically comparable controls in man makes the study of a lower animal, although vastly different psychologically, of great interest, since double first cousins—the closest relationship possible for such comparisons—can be used. The first criterion used for judging mental activity has been habit formation in a Watson puzzle box. The habit to be learned consists of a trip around behind the box, breaking an electric circuit and so opening the front door, and returning to the front, entering the box for the reward of food. The data recorded consist in the times required to open and enter the door of the puzzle box. Each rat has been given 225 trials; 145 rats have been employed in this training. The data, summarized in various ways, have been represented by graphs. Awaiting the results of a second set of training experiments of a different nature, which are being conducted as a check on the first method, no general conclusions are given and only provisional conclusions are drawn about the present work.

Rôle of the Lymphocytes in Resistance to Cancer:

JAMES B. MURPHY. (Introduced by JACQUES LOEB.)

Experimental Observations on Certain Phenomena of Growth: THOMAS B. OSBORNE and LAFAYETTE B. MENDEL.

The growth impulse, or capacity to grow, can be retained and exercised at periods far beyond the age at which growth ordinarily ceases. In the case of our experimental animals, albino rats, in which increment of body weight ordinarily ceases before the age of 300 days, resumption and completion of growth was readily obtained at an age of more than 550 days. It is now reasonable to ask whether the capacity to grow can ever be lost unless it is exercised. Even after *very prolonged* periods of suppression of growth, the animals can subsequently reach the *full size* characteristic of their species. In this respect there is no impairment of the individual. The satisfactory resumption of growth can be attained not only after stunting by underfeeding, but also after the cessation of growth which results when the diet contains proteins unsuitable for the synthetic processes of growth or is low in protein. Growth in the cases referred to is resumed at a rate normal for the size of the animal at the time. It need not be slow, and frequently it actually exceeds the usual progress. The size or age at which

the inhibition of growth is effected does not alter the capacity to resume growth. Even when the suppression of growth is attempted for very long periods at a very small size (body weight) the restoration may be adequate when a suitable diet is furnished. The procreative functions are not necessarily lost by prolonged failure to grow before the stage of development at which breeding is ordinarily possible. The period of growth may be greatly prolonged by inadequacies in the diet, so that growth becomes very slow without being completely inhibited. Though the time of reaching full size is thus greatly delayed, growth, as expressed by suitable body weight, can ultimately be completed even during the course of long-continued retardation. The methods of partially retarding or completely suppressing growth are too varied and unlike to permit final answers as yet regarding the outcome of all of the procedures of inhibition for the subsequent welfare of the individual. Our observations apply to the effects upon size and a few other incidental features mentioned. Although it is doubtful whether the fundamental features will be altered, far reaching dogmatic statements are scarcely justifiable until the experiments have been extended to include other factors and animal species. A detailed account of the work will appear in an early issue of the *Journal of Biological Chemistry*.

The Calorimeter as an Interpreter of the Life Processes: GRAHAM LUSK.

The measurement of the heat production in fermentation of sugar by yeast cells indicates a height of cellular activity, approximating that possible in the cells of mammalian tissue as has been shown by Rubner. The basal heat production in an adult man is very closely proportional to the surface area, although the age of the organism also plays an important part in this regard. In only a very few conditions of disease is the heat production decidedly changed. Thus, in conditions such as fever and exophthalmic goiter there is a largely increased heat production. Fortunately the ingestion of food under these circumstances does not cause a greater heat production than such food would effect if given to a normal man. In all diseased conditions there is no departure from the manner of utilization of the important food stuffs, with the striking exception of diabetes.

Ultramicroscopic Study of the Fibrin-gel: W. H. HOWELL.

The fibrin formed in the coagulation of blood has been described as consisting of a coarse net-

work of fibrils, but examination of the clot under the ultra-microscope demonstrates that it is deposited as a meshwork of needles or crystals, which are formed separately and subsequently cohere to make a firm gel. The traditional fibrin network must be considered as an artefact produced by mechanical stress. In diluted plasmas or in solutions of fibrinogen made to clot by the addition of thrombin, the process of formation of the needles can be followed to a certain extent. They develop by the aggregation of amicros to form visible particles which assume quickly the shape of short rods. These latter may exhibit at first very active movements, more abrupt and extensive than the ordinary Brownian movements. The minute rods lengthen into needles presumably by accretion, although the actual process can not be followed. The retraction of the clot is one of its characteristic properties and must be referred to a slow condensation of the needles due to a closer aggregation of the particles. A moderate concentration in hydroxyl-ions in the fibrinogen solutions or plasmas increases the degrees of dispersion of the colloidal particles, and in this condition the addition of thrombin causes the formation of a gel of an entirely different character. This gel is non-retractile and under the ultra-microscope reveals no visible structure. Neutralization or slight acidification, insufficient to precipitate the fibrinogen, restores the property of giving fibrin-needles by interaction with thrombin. With the exception of the gels of the sodium salts of the fatty acids described by Zsigmondy, fibrin is the only gel formed by an emulsion colloid which exhibits clearly a vectorial or crystalline structure. As far as the observations have been carried, this peculiar characteristic is exhibited by the blood of all the vertebrates. In the blood of invertebrates (crustacea), a different gel is formed in clotting.

Origin of the Flight of Birds: C. WILLIAM BEEBE.
(Introduced by HENRY FAIRFIELD OSBORN.)

Mr. Beebe has discovered both in the young of living birds and in *Archæopteryx* a series of powerful flight feathers on the hind limb, which he will demonstrate in support of a new theory of the origin of the flight of birds.

Ornithological Survey of the Andes and Western Coast of South America: FRANK M. CHAPMAN.
(Introduced by HENRY FAIRFIELD OSBORN.)

The ornithological survey of the west coast of South America and of the Andes is now in its fourth year. It is organized along the lines which the United States Biological Survey has intro-

duced in this country. Dr. Chapman will present a *resumé* of the methods of exploration of the area already covered and of the principal results attained in regard to the origin and geographic distribution of the bird life of western South America.

The Archegonium and Sporophyte of Treubia insignis Goebel: DOUGLAS HOUGHTON CAMPBELL.
(To be read by PROFESSOR COULTER.)

Treubia is a remarkably large liverwort discovered by Goebel in western Java. It has since been found in several widely separated regions. The writer discovered it on Mt. Banajao, Luzon, the only station yet reported for the Philippines. The material for the present paper was collected by the writer at the original station, Tjibodas, in western Java, in 1906. The archegonium differs from that of other liverworts in the increased number of rows of peripheral cells in the neck, there being always more than six. The young embryo has a large haustorium, much like that found in *Podomitrium* or *Pallaircinia*. The foot is not clearly delimited, and the differentiation of the sporogenous tissue takes place at a later period than is usual. No elaterophore is present, and no definite relation of spore mother-cells and elaters can be detected. The elaters finally become very long. A very massive calyptra is developed. The ripe capsule is ovoid in form, and opens by four somewhat irregular valves. *Treubia* probably is the nearest to the typical leafy liverworts (*Acrogynæ*), of any anacrogynous liverwort.

Fossil Calcareous Algæ from the Panama Canal Zone, with Reference to Reef-building Algæ: MARSHALL A. HOWE. (Introduced by N. L. BRITTON.)

After referring to the recent marked development of interest in the fossil calcareous algæ and the increasing recognition of their importance in the formation of limestones, the speaker will discuss in some detail certain Lithothamnizæ, collected in Pleistocene and Oligocene strata of the Panama Canal Zone by T. Wayland Vaughan and D. F. MacDonald, of the United States Geological Survey. Lantern slides will be shown illustrating the habit and microscopic structure of three species which are to be described as new. One of these, from the Pleistocene flats near Mt. Hope, the speaker considers to be represented also by living specimens found by him in the Colon region, only a few kilometers distant. The other two, from the Oligocene, perhaps find their nearest relatives in certain fossils from the Tertiary of Austria.

Sterility in Plants and its Inheritance: A. B. STOUT. (Introduced by N. L. BRITTON.)

The different types of sterility are discussed as a basis for the presentation of data on the phenomena of self and cross sterility involving physiological incompatibility. The evidence pertaining to the behavior and inheritance of this type of sterility in the flowering plants is summarized and original data presented giving the results of controlled self and cross pollinations with *Cichorium Intybus*, which involve nearly 500 plants and 125,000 individual flowers. The existence of self and cross sterility within this species is established, and the appearance of self-fertile plants is reported. Progenies of self-fertile plants have been studied into the third generation exhibiting with respect to self and cross sterility very irregular behavior and most sporadic inheritance.

Recent Explorations in the Cactus Deserts of South America: J. N. ROSE. (Introduced by N. L. BRITTON.)

The field work in connection with the cactus investigation of the Carnegie Institution of Washington contemplated a study of the deserts of not only North America but also of South America, the latter of which had never been thoroughly and consecutively explored. Two seasons have been given to South America, where an enormous amount of material has been gathered. The three following great deserts have been explored: First, the desert of western Argentina. This includes all of western Argentina. It resembles in its component parts the deserts of Arizona. Second, the desert of central Brazil. This is composed of the western parts of the states of Bahia and Pernambuco. It is very similar to the desert region of Santo Domingo, and the typical genera are nearly all West Indian. Third, the desert of Peru and Chile. This comprises all of western Peru and northern Chile. Its flora is the most distinct of any of the South American deserts.

Some Factors Affecting the Inheritance Ratios in Shepherd's Purse: GEO. H. SHULL. (Introduced by CHAS. B. DAVENPORT.)

The Respiratory Ratio of Cacti in Relation to their Acidity: HERBERT M. RICHARDS. (Introduced by R. A. HARPER.)

Some Studies in Morphogenesis: R. A. HARPER.

Can We Observe Organic Evolution in Progress? HERBERT S. JENNINGS.

Orthogenesis in Plants: JOHN M. COULTER.

The gymnosperms furnish the best illustrations among plants of what is called progressive evolution, or orthogenesis. Many lines of advance can be traced in unbroken series from the Devonian to the present time, involving structures that have been assumed to be beyond the influence of external conditions. Three such lines are used as illustrations. (1) *The Egg*.—In the history of gymnosperms there is a gradual shifting of the time of appearance of the egg in the ontogeny of the gametophyte. In the most primitive forms the eggs appear at the full maturity of the gametophyte. An unbroken series can be traced, representing an earlier appearance of eggs, extending from full maturity of the gametophyte, to very early embryonic stages. Experimental work upon sexuality in plants has shown that the appearance of gametes is in response to certain conditions of metabolism, and these conditions are associated with minimum vegetative activity. Any change of conditions shortening the period of vegetative activity would thereby hasten the appearance of eggs in the ontogeny of the gametophyte. This is exactly the result that, in the case of gymnosperms, would follow the differentiation of the year into definite seasons. The conclusion is that orthogenesis in this case holds some relation to the evolution of climate. (2) *The Proembryo*.—A similar illustration of progressive evolution is offered by the earlier and earlier appearance of wall-formation in the development of the proembryo, until the stage of free nuclei is eliminated. Since the progressive changes in the appearance of eggs and the development of the proembryo in general proceed *pari passu*, the inference is that they are both responsive to the same changing conditions. (3) *The Cotyledons*.—Recent work has shown that the number of cotyledons is also a response to conditions affecting vegetative activity. Among the causes that determine the progress from polycotyledony or dicotyledony to monocotyledony, a conspicuous one is the rate of growth of the subsequent members of the embryo, and this rate is a response to conditions for vegetative activity. The general conclusion is that the phenomenon of orthogenesis among plants is to be explained, not as the result of an "inherited tendency," but as a continuous response to progressive changes in the conditions of vegetative activity.

Investigations Recently Conducted in the Wolcott Gibbs Memorial Laboratory: THEODORE W. RICHARDS.

The Life of Radium: B. B. BOLTWOOD.

Experiments and Theory of Conical Horns; Instruments for Measurements of Sound; An Instrument for Finding the Direction of a Fog-signal: A. G. WEBSTER.

The Biography of Alfred Marshall Mayer: ALFRED G. MAYER and ROBERT S. WOODWARD.

The Solar Radiation and its Variability: G. C. ABBOT.

The New Draper Catalogue: EDWARD C. PICKERING.

One of the largest pieces of routine work undertaken at the Harvard College Observatory is the New Draper Catalogue. Its object, primarily, is to furnish the class of spectrum of all the stars so far as they can be determined from existing photographs. This classification was undertaken by Miss Annie J. Cannon, in October, 1911, and, by observations persistently maintained for four years, this portion of the work was practically completed, September 30, 1915. During this period, she classified 233,050 spectra, thus covering the entire sky. Meanwhile, 196,768 of these stars have been identified, and 194,820 of them entered in the card catalogue. The entire work will fill nine of the quarto volumes of *Annals* of the observatory, and will also give photometric and photographic magnitudes of all the stars on a uniform scale.

On the Albedo of the Moon and Planets: HENRY NORRIS RUSSELL. (Introduced by EDWARD C. PICKERING.)

A Possible Origin for Some Spiral Nebulæ: GEORGE F. BECKER.

The paper seeks to show that the spiral, $r^2\phi^2 = \text{constant}$, is of use in interpreting the phenomena.

Concomitant Changes in the Earth's Magnetism and Solar Radiation: L. A. BAUER. (Introduced by R. S. WOODWARD.)

The author's preliminary conclusions respecting appreciable changes in the earth's magnetic state, concomitant with changes in the intensity of solar radiation as shown by Abbot's solar-constant values, are confirmed by a fresh investigation based upon solar and magnetic data for 1913 and 1914. It is found, for example, that decreased solar constant is accompanied by an increase in the constant used to define, at any time, the earth's magnetic state, and by a decrease in the range of the diurnal variation of the earth's magnetism. The numerical relationship between changes in solar constant and magnetic constant, or in the magnetic diurnal range, is shown to be sufficiently definite to strengthen the conclusions reached by Abbot respecting the sun's variability.

Diagrams were exhibited showing how, with the aid of the relation found, certain puzzling features respecting the secular variation of the earth's magnetism and its so-called "non-cyclic daily change," may be readily explained.

Experiments on the Mean Free Path of Gases: Observations on Wood's One-dimensional Gas: FRED E. WRIGHT and J. C. HOSTETTER. (Introduced by ARTHUR L. DAY.)

In a paper on "One-dimensional Gases and the Experimental Determination of the Law of Reflection for Gas Molecules," presented before this academy at its April meeting, Professor R. W. Wood directed attention to interesting phenomena which he ascribed to reflection of mercury atoms from an optically plane glass surface. Inspired by this paper it occurred to us to apply Wood's method to crystal plates and to ascertain if the crystal symmetry affects the distribution of the reflected mercury atoms. The experiments, with the exception of two which yielded no results of value, were all performed during the month of May, but the publication of the results has been postponed for reasons beyond our control. Our preliminary results led at once to the construction of a new piece of apparatus by means of which evidence was obtained proving that a large part of the phenomena are to be explained on the basis of the kinetic theory of gases; they show that in high vacua of pressures of only 0.2 bar there is still sufficient gas present to inhibit the formation of "one-dimensional gas." The experiments illustrate, moreover, the change, with pressure, of the mean free path of a given gas. Computations on the basis of the kinetic theory are in agreement with the experimental evidence and serve also to explain the clear zonal ring of no reflection observed both by Wood and by us.

The Water Correction in Conductivity Determinations: JAMES KENDALL. (Introduced by ALEXANDER SMITH.)

Conductivity water, however carefully prepared, can not be kept for more than a few minutes in contact with air without its specific conductivity rising to about 0.9×10^{-6} reciprocal ohms at 25° C. This is the same as the calculated specific conductivity of water saturated with carbon dioxide under its atmospheric partial pressure (3.69 parts in 10,000). It is therefore possible to eliminate entirely the influence of the water in exact conductivity measurements by correction for dissolved carbonic acid. This has been done for very dilute solutions of strong electrolytes (Arrhenius), transition electrolytes (Kendall), and weak elec-

trolytes (Walker and Kendall). The results in all cases confirm the assumption that the correction thus applied is valid and complete.

Extremes of Adaptation in Carnivorous Dinosaurs, Tyrannosaurs and Ornithominius. HENRY FAIRFIELD OSBORN.

Complete skeletons of two of the most remarkable types of carnivorous dinosaurs, *Tyrannosaurus* and *Ornithominius*, are mounted and exhibited especially at this meeting of the academy. Dr. Osborn will describe the two extremes of carnivorous dinosaur adaptation which they respectively represent.

Influence of Certain Minerals on the Development of Schists and Gneisses. C. K. LEITH. (Introduced by C. R. VAN HISE.)

A brief account of the development of quantitative methods in the study of the metamorphic cycle, leading up to a consideration of the formation of schists and gneisses. Evidence is presented to show that the development of schists and gneisses means convergence to a few mineral types, and that the characteristics of a few minerals determine to a large extent the course of chemical, mineralogical and textural changes in dynamic metamorphism.

Sculpture of the Mission Range, Montana. W. M. DAVIS.

The Mission Range, one of the smaller members of the Rocky Mountains in western Montana, composed of deformed rocks, chiefly quartzites, has the appearance of a tilted and dissected fault block, trending north and south, about 70 miles in length. The steeper face, probably representing the battered fault scarp, looks to the west. The low northern crest of the range emerges from the glacial deposits that floor the surrounding intermont depression at an altitude of 3,000 feet, and rises slowly southward with moderate undulation to an altitude of 9,500 feet near its abrupt southern end. The eastern side of the range is said to slope more gently than the steep western face. The present features of the range due to erosion since uplift, as seen from the intermont depression on the west, may be divided into three oblique belts by two nearly parallel south-dipping planes, about 1,000 feet apart. The middle belt has smoothly-rounded summits, and full-bodied, large-textured, waste-covered spurs of mature normal degradation between wide-spaced, steep-pitching, consequent valleys. The upper and southernmost belt includes, besides the rounded, waste-covered forms of normal erosion, bare-walled cirques and

troughs of local glaciation in more than a score of its high-reaching valleys; these features are best developed at the high southern end of the range, where the crest is locally sharpened into Alpine arêtes, and where the troughs, encroaching most broadly on the intervening spurs, reach down to the mountain base; at the middle of the range where its height is less, the cirques are faintly developed and the troughs extend only a few hundred feet down these valleys. The lower and northernmost belt shows many crags and knobs, cliffs and ledges, channels and hollows due to erosion by a broad and overwhelming glacier of Canadian origin. The northern half of this belt, or roughly, the northernmost fourth of the range, lies entirely beneath the slanting limit of Canadian glacial action, and is of disorderly form to its crest; the northernmost knobs, more or less detached from one another, rise hardly a hundred feet above the gravel plain: the southern half of the belt, in the second fourth of the range, preserves rounded normal forms along its crest and lower and lower down on its flanks as mid-range-length is approached; its valleys are barred across by morainic embankments along the slanting limit of the Canadian glacial action, and its spurs are imperfectly truncated in rugged facets which descend abruptly into Flathead lake. The height of the facets and the altitude of the embankments decrease southward; the facets become smaller and less continuous; the embankments become longer, larger and more continuous, until, curving away from the range base they unite in a noble terminal moraine, 400 or 500 feet in height and a mile or more in breadth, which swings westward across the intermont depression, separating Flathead lake on its northern concave side from the Mission plains of earlier glaciation on its southern, convex side. As far as I have seen and read, the Mission range is unique in its systematic tripartite arrangement of normal and glacial features.

Crystallization of Quartz Veins. WALDEMAR LINDGREN.

The Minor Constituents of Meteorites. GEORGE P. MERRILL. (Introduced by A. L. DAY.)

A Peculiar Clay from near the City of Mexico. E. W. HILGARD.

KARL EUGEN GUTHE

At the first meeting of the year the president of the Research Club of the University of Michigan read the following words of appreciation of the late Professor Guthe: